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AUTHOR Flagg, Barbara N.; And Others  
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## ABSTRACT

Formative research on the eye movements of children in the older age range of "Sesame Street's" target audience was conducted and results were used to answer a range of formative questions concerning television programing goals and their implementation. Forty-six low-income, black and caucasian children, ranging in age from 4.9 to 6.9 years participated in the study. Research procedures used involved (1) the administration of the Sesame Street Familiarity Test (SSFT), a measure specifically designed for this study, as well as other pertinent questions, (2) equipment calibration and viewing of one show consisting of several segments, (3) refreshment break, post-questioning and administration of the Peabody Picture Vocabulary Test, (4) viewing a second show, (5) post-questioning concerning the second show, and (6) compensation payment to the subject. The purpose of all pre- and post-viewing questions was to determine the extent to which the child comprehended the instructional message of the segment viewed. Segments focused on numbers, letters of the alphabet, and classification concepts. Results are presented for performance on measures used. No sex or race effects were found. Subsequent discussion describes the viewing patterns and post-viewing results for each of the 23 segments in the three shows. In concluding remarks, format design variables considered important in attracting and maintaining the child's visual attention are pointed out. Related materials are appended.  
(Author/RH)

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CHILDREN'S VISUAL RESPONSES

TO SESAME STREET

Barbara N. Flagg

Bonita D. Allen

Abigail H. Geer

Leonard F. Scinto, Jr.

"PERMISSION TO REPRODUCE THIS  
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## INTRODUCTION

In the production of a children's television program the goal of formative research is to provide feedback relevant to the actual program design so as to optimize attention to and comprehension of the instructional message (Palmer, 1972). As Samuel Gibbon, an executive producer of Children's Television Workshop, points out,

Currently the producer of television must rely largely on intuition and rating surveys to guide him in the design of his messages. We need to know the factors that govern the deployment of attention within the televised display and the variables which determine how well the material is comprehended. We need to measure the effectiveness of television presentations in the laboratory to obtain precise information about attention and comprehension enabling us to improve our manipulation of television's properties for much larger distant audiences from whom feedback cannot be received (Gibbon, et al., 1974).

Considerable formative research has been done on what information is extracted from TV, that is, on the overall instructional effectiveness of a program. Little emphasis, however, has been placed on how the information is extracted or why educational goals have not been realized. After-the-fact research methods are limited in that they do not tell what in the television presentation is actually affecting the achievement of the program goals. We can only acquire the latter information by looking at the viewer's moment-to-moment response while he is watching the program. A research method which gives us a unique opportunity to investigate the actual distribution of the viewer's attention while he is watching involves the

recording of the viewer's eye movement patterns. Eye movement patterns are real-time, rapid, continuous indicators of the viewer's visual attention and processing.

#### Television and Eye Movements

Television must be perceived and understood as a moving and changing mosaic presentation of images and sounds. Eye movement data provide an objective continuous record of the interaction between elements of the television presentation and the viewer's perception and cognition. Information obtained by means of eye movement recordings can be a powerful tool for the analysis of children's viewing, processing and final assimilation of television programming. Particularly in the area of formative studies, eye movement research can address the critical design questions of the optimal formats, pace, and balance of entertainment and education, given specific programming goals. This method provides direct feedback on whether particular instructional elements are attended to within a display and which aspects of the material are most appealing and salient. Viewing pattern data coupled with supplemental measures such as spontaneous verbal and gestural responses or pre- and post-test comprehension and attitude questionnaires yield a comprehensive picture of the processing of television by children.

The potential of eye movement recording in formative research has recently been recognized and significant studies on The Electric Company have been produced by Kenneth O'Bryan's lab (O'Bryan and Silverman, 1972; O'Bryan, 1974; Mock, 1975; Hodapp and O'Bryan, 1975). However, only recent innovations in recording equipment allow us now to overcome some limitations of O'Bryan's facility and to extend the use of this research technique to

the Sesame Street target age group and stimulus presentations of longer duration.

#### Eye Movements

Eye movements have been demonstrated to be functionally related to information intake and cognitive processing. An intimate connection appears to exist between the behavior of the eye and the higher cognitive processes which guide that behavior and, in turn, are informed by it. Yarbus (1967) asserts that eye movements reflect the thinking process itself. Piaget (1969) claims that eye movement patterns are directly determined by certain operative cognitive structures of the mind.

The complex, visual-motor system is designed to acquire and track visual targets and to inspect stationary targets. The fovea centralis, the small region of the eye's retina most densely packed with photoreceptors, is capable of the greatest visual acuity. The acquisition of detailed visual information requires that the eyes move about such that successive images of the visual field fall upon the fovea. Movements about the visual field are called saccades and the times during which an image is centered on the fovea are called fixations. Saccades are relatively fast movements of the eyes used to pick up a visual stimulus. Once a visual target is acquired, we speak of it as being fixated because the foveal region is fixed on the target.<sup>1</sup>

It is during fixations that the intake and assimilation of visual information takes place. The position and duration of fixations reflect the continuous cognitive processing of the visual display. Saccadic movement, when one considers its pattern and direction over a display,

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<sup>1</sup>For a more detailed discussion of the oculomotor system, see Burde (1975).

can be an important index of the integration of visual information. The pattern of saccades and fixations is determined by the visual stimulus as well as by the perceptual and cognitive processes of the viewer. The significance of these facts for television research cannot be overestimated given that the primary sensory mode for processing the medium is the visual sense.

#### Design

The formative research reported here deals with the older age range of Sesame Street's target audience. Information generated by this study was not restricted to any particular hypothesis; rather the data collected are used to answer a whole range of formative questions concerning programming goals and their implementation. In general, the broad areas of both style of presentation and content are subjected to analysis.

The data collected represent the flexibility of eye movement research to deal with any number of issues critical to formative studies of television programming. The applicability and usefulness of eye movement research as a powerful heuristic for investigating the processing of television is only limited by our ability to formulate those questions that require answering.

## METHOD

## Subjects

Forty-six black and white children participated, ranging in age from four years, nine months to six years, nine months, with a mean age of five years, six months (see Table 1). Our recording facility could not accommodate an additional seven children due to their excessively small pupil diameters or drooping eyelid/eyelash configurations and an additional three children who were hyperactive and would not sit still to watch the show. These children did not differ significantly in any other way from our actual sample.

The participants consisted of eleven black males, ten black females, twelve white males, and thirteen white females. Table 1 shows the distribution of subjects by sex and race as well as presenting the mean age and age range of each group.

The children were volunteers drawn from low-income families in Boston and in Cambridge, Massachusetts. The parents were contacted through day care centers with welfare contracts, Head Start centers, and other community programs for underprivileged children.

## Stimulus

Sesame Street Experimental Videotapes. To minimize each child's viewing time in the eye movement recording situation and to insure that sufficient data were gathered, the original Sesame Street stimulus tape received from Children's Television Workshop was divided into three Shows. (See Appendix A for a listing of the segments included in each Show.) Each Show is approximately fifteen minutes long, and a subject

watched two shows divided by a break. Table 1 gives the number of subjects who viewed the Shows; three subjects viewed only one show due to logistic problems. Thus, every child but three viewed approximately thirty minutes of Sesame Street.

Calibration Videotape. Prior to each Show, the subject watched a three-minute animated videotape. During this time the recording equipment was calibrated. Calibration requires that the subject fixate at specific times five points on the screen: center, left, right, top, and bottom. Since young children are not known for their ability to follow instructions, a stimulus is needed that attracts and holds their visual attention at the specific points on the screen. The Calibration Videotape presents animated "dots" one at a time at each of these points. The design and activity of the "dots" along with appropriate sound effects attract and maintain the subject's eye on the position long enough for the experimenter to calibrate the recording equipment.

#### Apparatus

The Sesame Street stimulus is shown via video cassette on a 17-inch black-and-white television monitor placed approximately three feet away from the subject's eyes and slightly above eye level. A Whittaker Corporation Eye-View Monitor and TV Pupillometer System is employed to monitor eye movements and pupil diameter. The system uses a sensitive television camera, which functions at very low illumination, to view the left eye.<sup>2</sup> The camera is approximately one foot away from the subject's eye and out of his direct field of view. The point-of-regard is determined

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<sup>2</sup>It is possible to record point-of-regard from one eye only because both eyes move together to the same fixation point.

Table 1

Subject Characteristics

|         | No. of Subjects<br>who viewed one<br>or two shows <sup>a</sup> | No. of Subjects who viewed each Show <sup>a</sup> |         |          | Age Range<br>(Years: Months) | Mean Age<br>(Years: Months) |
|---------|----------------------------------------------------------------|---------------------------------------------------|---------|----------|------------------------------|-----------------------------|
|         |                                                                | Show I                                            | Show II | Show III |                              |                             |
| Black   |                                                                |                                                   |         |          |                              |                             |
| Males   | 11                                                             | 7                                                 | 7       | 7        | 4:9-6:3                      | 5:8                         |
| Females | 10                                                             | 6                                                 | 6       | 7        | 4:11-6:9                     | 5:7                         |
| Total   | 21                                                             | 13                                                | 13      | 14       | 4:9-6:9                      | 5:7                         |
| White   |                                                                |                                                   |         |          |                              |                             |
| Males   | 12                                                             | 8                                                 | 8       | 8        | 5:0-6:1                      | 5:6                         |
| Females | 13                                                             | 8                                                 | 9       | 8        | 4:11-6:6                     | 5:5                         |
| Total   | 25                                                             | 16                                                | 17      | 16       | 4:11-6:6                     | 5:5                         |
| Total   | 46                                                             | 29                                                | 30      | 30       | 4:9-6:9                      | 5:6                         |

<sup>a</sup>All but three subjects viewed two Shows.

by tracking the position of the center of the pupil relative to the position of an infrared light reflection off the subject's cornea. The pupil center and the corneal reflection move together with head motion, but move differentially when the eyes rotate within the head; thus, the difference in these positions is indicative of the eye's point-of-regard.

In order to accurately record eye-movements, the eye must remain within the field of view of the television camera, hence the child is asked to sit as still as possible during the viewing. Seated in a comfortable adjustable chair, the child is aided in sitting still by a padded head- and chin-rest which restricts gross head-movements but allows for verbalizations and small head-movements. The recording system samples eye position 30 times per second and produces a videotape of the television stimulus with the subject's eye movement path superimposed on the stimulus as a spot of light.

#### Procedure

The children participating in the study were accompanied to our eye movement recording facility by a parent or other responsible adult who was encouraged to remain<sup>in</sup> the room while the child watched television. The parent was not involved in any of the procedures but received information concerning our purpose and procedures prior to the child's visit.

A black female experimenter (E1) was primarily responsible for all testing and communication with the subject. The second experimenter (E2), a white male or white female, was primarily responsible for operating the recording equipment. Before viewing any television every effort was made to help the child feel comfortable with both the experimenters and the experimental situation.

The general procedure, described in more detail below, was as follows:

1. The Sesame Street Familiarity Test was administered first. If the child was to view the Monster Opera segment, he was asked some previewing questions.
2. The subject then viewed the Calibration Videotape and one Show.
3. During a refreshment break following the viewing, the child was questioned about the Show he just saw, and the Peabody Picture Vocabulary Test was given.
4. A second Show was watched.
5. Postviewing questions were asked about the second Show.
6. The subject received \$3.00 compensation.

The purpose of all the pre- and postviewing questions was to determine the extent to which the child comprehended the instructional message of the segment considered. Due to time constraints, we decided to use viewing questions only for those segments for which we could clearly relate the comprehension results to the viewing patterns or to pupil diameter results (as in the case of the Monster Opera). These relationships are considered in the Results and Discussion section.

Sesame Street Familiarity Test. The Sesame Street Familiarity Test (SSFT) was specifically designed for this study and involves asking the child to verbally identify pictures of nineteen different Sesame Street characters ranging from the universally known Cookie Monster to the not-so-well-known Muppet, Mary Lou. The test is designed such that a picture of each character is hidden behind a door on a piece of cardboard. As E1 opens the doors, she asks the child to name the picture and E2 records the

response. The purpose of administering our SSFT was to determine how familiar each child is with Sesame Street and its characters. (See Appendix B for a list of characters included in the SSFT.)

Monster Opera Previewing Questions. If the child were scheduled to view the Monster Opera segment in Show II, he was asked a number of questions after he recognized the picture of Cookie Monster (CM), the last character presented in the SSFT. These questions were designed to determine the child's attitude toward "monsters" and were used as standard opening probes. Several times a child's answer was indefinite and further questioning was required. The following questions were asked by El:

\*You know, a little girl named Susan came to visit us yesterday, and she said that she didn't think CM was a real monster. Do you think CM is a real monster?

\*What are real monsters like?

\*Do you ever think about monsters?

\*Do you ever dream about monsters?

\*Do CM and the other monsters you see on Sesame Street scare you?

\*Do monsters like those you see on "Double Creature Feature" scare you?

Peabody Picture Vocabulary Test. During the refreshment break, El administered the Peabody Picture Vocabulary Test (PPVT). The PPVT is designed to provide an estimate of a subject's verbal intelligence through measuring his hearing vocabulary. The procedure consists of El showing the child four pictures and saying a word. The child is to point to the picture which best fits the word given. The PPVT was employed because it is short, easy to administer, and was used by the Educational Testing

Service in their summative evaluation of Sesame Street. We have included it in our procedures primarily to establish the generality of our sample of subjects.

Show I Postviewing Questions. After viewing Show I, E1 asked the child some questions concerning the segments How Are You? Fine! and Number 4 Machine. E2 recorded the child's responses.

\*Remember on the show, they tried to teach you to talk with your hands? Can you ask me how I am in sign language? Do you remember how to say "Fine?"

The experimenter questioned the child in such a way as to determine whether he could indeed perform the sign language movements spontaneously or whether he needed prompting. E1 also determined whether the child differentiated "How Are You" from "Fine," if the child's response was unclear in this respect.

The subject was questioned about the Number 4 Machine segment by presenting him with a two-dimensional cardboard model of the machine. We felt that a visual reproduction of the segment would help to induce recall of what is primarily a visual message. In addition, giving the child the elements of the scene to manipulate might both facilitate and reflect his understanding of the segment in a way that verbal prompting and verbal responses might not. Showing the child the model, E1 asked:

\*Do you remember this machine from the show?  
Remember how four ships and four men went into  
the machine and a number four came out?

E1 then placed five paper fish on the board and pushed them on top of the entrance to the machine.

\*How many fish do I have here?

If the child miscounted, El counted with the child. El next placed four paper numbers at the base of the machine facing the child (#5, #4, #6, #3).

\*What do you think comes out when five fish go into the machine?

If the child answered "five fish" or the number "four," El probed with a variation on the above procedure to determine what the child recalled about the segment and whether he understood the principle involved, that if N objects enter the machine then the number N should exit. El then proceeded to determine if the child could generalize the principle to another number by repeating the procedure with three fish.

Show II Postviewing Questions. The following questions were asked concerning the Monster Opera:

\*Do you remember how Bert was trying to go to sleep and Ernie kept bothering him? Boy, I'm telling you, that Ernie just wouldn't let Bert go to sleep. Do you remember why Ernie kept waking Bert up? (Child responds with a comment about the monsters.)

\*That's right; he thought he saw monsters. What did you think of those monsters?

\*Were they real monsters?

\*Did you think they were scary?

If necessary El would add the following questions to help draw out the child's responses:

\*What did you think of those monsters? I thought they were kind of cute and cuddly, what did you think?

\*You know, they sang a song and said that they were friendly. Did you think they were friendly?

\*Would you like to invite them home for dinner, or maybe have stuffed animals like that?

The purpose of these questions was partially to determine the reality/fantasy distinctions of the child but also to gauge the extent of the child's emotional response to monsters on and off Sesame Street. This information was eventually to be related to pupil diameter changes during the Monster Opera viewing (see Results and Discussion section).

Show III Postviewing Questions. The child was shown a two-dimensional cardboard model of the Number Five Grid and asked the following questions:

\*Do you remember this machine from the show?  
Do you remember how a number five went in here  
and five things came out?

El then placed six paper houses at the base of the machine facing the child and pushed a number four partway through an opening in the grid model.

\*What do we have here? Oh, we have some houses.  
How many houses do you think would come out  
here if a number four went into the machine?  
Can you show me?

\*How many houses would come out if a number  
six went into the machine?

If a child appeared to have difficulty with the questions, El referred back to the show or prompted the child in order to discover whether the subject misunderstood the experimenter or the segment.

Giving our apologies to Jean Piaget, a very brief attempt was made to determine whether the subjects could conserve number (George's Farm

and No Matter How You Count Them). Five small blocks were laid side by side on the table and the child was asked to count them. El helped count if necessary.

\*Now suppose I take these blocks and I scoop them all up into a big pile like this. Now how many blocks do I have?

\*Now, suppose I take these blocks and I stack them all up on top of one another like this. Now how many do I have?

If it is apparent that the child has to count to say "five," then he is considered a non-conserver.

Shows I, II, and III Postviewing Questions. All of the children were asked a final question about words beginning with the letters F, D, and H. Some of the children saw segments using these letters, others did not.

\*I want you to close your eyes for a second.  
(El puts her hand over her eyes for the child to imitate.) Can you think of any words that begin with the letter F, with an f sound?

\*Can you think of any words that begin with the letter D, with a d sound?

\*Can you think of any words that begin with the letter H, with an h sound?

If the child did not offer any words, El gave hints. For example, she would hold up four fingers, mimic a dog -- "arf, arf" -- or hold out a lock of hair asking "what's this?"

#### Analysis

Coding of the eye movement videotapes was done manually at slow-motion and still-frame speeds determining where the subject fixated, how often, and approximately how long.

## RESULTS AND DISCUSSION

Sesame Street Familiarity Test

The SSFT, as described above, presents 19 Sesame Street characters for identification. Table 2 lists the mean number of characters identified correctly by each subject group with an overall sample mean of 8.3 characters or 43%. No significant difference was found between males and females, but the white children identified significantly more characters than the black children ( $p < .01$ ). As we note below, this difference in familiarity with the show does not seem to affect the way the two groups visually scanned the television presentation.

Table 3 lists the characters in their order of familiarity to our sample. Cookie Monster heads the list with all the children recognizing him, and Big Bird was identified by all but two subjects. These Muppets are probably the most seen on television, on Sesame Street as well as on other shows and commercials. The six most familiar characters were Muppets; less familiar were the live characters, even though they perhaps refer to each other by name more often than the Muppets. At the end of the list we find those Muppets who do not appear on the show very often and predictably were less familiar. These characters were included in the test to eliminate a ceiling effect. Surprisingly, the black characters (Gordon, Susan, and David) were recognized more often by the white sample than by the blacks, and only two children from each group identified Roosevelt Franklin correctly.

## Peabody Picture Vocabulary Test

Table 2 presents the results of our sample on the Peabody Picture

Table 2  
Mean SSFT Scores and Mean PPVT Mental Ages

|              | Mean No. of Sesame<br>Street characters<br>correctly identified<br>(out of 19) | Mean Age<br>(Years:Mos.) | Mean Mental<br>(Years:Mos.) |
|--------------|--------------------------------------------------------------------------------|--------------------------|-----------------------------|
| <b>Black</b> |                                                                                |                          |                             |
| Males        | 6.6                                                                            | 5:8                      | 4:11                        |
| Females      | 6.1                                                                            | 5:7                      | 5:0                         |
| Total        | 6.4                                                                            | 5:7                      | 4:11                        |
| <b>White</b> |                                                                                |                          |                             |
| Males        | 9.8                                                                            | 5:6                      | 6:8                         |
| Females      | 10.5                                                                           | 5:5                      | 5:8                         |
| Total        | 10.1                                                                           | 5:5                      | 6:3                         |
| <b>Total</b> | <b>8.3</b>                                                                     | <b>5:6</b>               | <b>5:8</b>                  |

Table 3

Sesame Street's Characters in Order of Familiarity

| Characters         | Percent of subjects who<br>correctly identified the<br>character |
|--------------------|------------------------------------------------------------------|
| Cookie Monster     | 100%                                                             |
| Big Bird           | 96                                                               |
| Ernie              | 72                                                               |
| Oscar              | 67                                                               |
| Count              | 65                                                               |
| Bert               | 57                                                               |
| Mr. Hooper         | 50                                                               |
| Grover             | 48                                                               |
| David/Maria        | 43                                                               |
| Snuffalophagus     | 35                                                               |
| Bob                | 33                                                               |
| Susan              | 30                                                               |
| Gordon             | 26                                                               |
| Hairy              | 22                                                               |
| Little Bird        | 20                                                               |
| Luis               | 17                                                               |
| Roosevelt Franklin | 9                                                                |
| Mary Lou           | 2                                                                |

Vocabulary Test. The mean mental age of the black group is lower than their mean age while the opposite is true of the white group. No significant difference in mental age was found between males and females, but the white sample produced a significantly higher mental age than the black sample ( $p < .01$ ). We must note in considering these results, however, that the PPVT was standardized on white children surrounding Nashville, Tennessee. Moreover, as noted below, the black and white groups did not differ in their Sesame Street viewing patterns despite their apparent difference in mental age.

#### Group Differences

Surprisingly there were virtually no differences between the subjects divided by sex or race in either their viewing patterns or their pre- or postviewing responses. If exceptions were found to the general pattern, they occurred in all sub-groups, not in one alone. This result, though disconcerting to those who always look for differences, should be encouraging to the producers of Sesame Street. That a child views the show in basically the same manner whether that child is a he or she, black or white, is a significant finding for a program which must appeal to all disadvantaged children. This is not to say, however, that individual differences did not exist or that different group viewing patterns did not occur; only that these differences cut across lines of sex and race.

## SYMBOLIC REPRESENTATION: NUMBERS

Format: Numeral/Number of Objects Relationship

Number 4 Machine

Viewing Patterns. The amount of pictorial detail and action contained within this bit makes it a visually complex segment. The single object fixated most frequently by all subjects was the machine operator at the top of the machine. His prominent position and the fact that he is often the sole animated figure within the scene contributes to his drawing power. He is also available for inspection far longer than the objects which simply pass through the machine.

Of the objects entering the machine, the ships attracted the most attention from all subject groups. This pattern could be due to the fact that the action of the objects has become obvious by the time the ships enter late in the segment. The fire engines, which are the first objects, were fixated least often by the majority of children. These two findings demonstrate the need for repetition of action patterns in a segment as visually complex as this in order to insure the viewers' attention to appropriate events.

The pace at which objects appear and enter the machine alters from group to group. The size of the objects varies also. We note frequently in this report that different sizes of objects draw varying amounts of visual inspection, larger objects usually eliciting a greater amount of attention. It is possible that the varying pace and size of the sets of objects are partially responsible for the differing attention patterns. A regular pace and size may elicit more uniform scanning patterns and reinforce the expectations of the viewers.

The entrance and exit of the machine were fixated an almost equal number of times with a slight preference given to the entrance. This could simply be a consequence of the prominence of the entrance while the exit is often hidden from view throughout the segment. A significant number of fixations fell on irrelevant items. The black pulsating funnel elicited the most attention. This is probably related to its central position, regular pulsating rhythm and rather prominent size. As there seemed to be no rational or causal connection between the funnel and the relevant goals of the segment, such an object can only be considered a distracting element in an already visually complex scene. The introduction of action in conflict with segment goals and the inclusion of irrelevant objects which draw attention through their position and size should be avoided where possible in the design of segment formats.

No particular fixation pattern emerged from the data. However, most subjects pursued at least one group of objects passing through the process of the machine. The viewers fixated the objects as they passed into the entrance, then picked up the number four at the exit and followed its movement off the screen. Only thirty-five percent of the subjects exhibited viewing patterns that clearly indicated a foreknowledge and anticipation of the outcome. These children would fixate ahead of the objects' actual movements. For most subjects, fixations were random and varied over a wide range of positions. The format of the segment was not powerful enough to model eye movement patterns such that regularity was achieved across subjects.

Postviewing Results. As described in the Procedure section, subjects were requested after viewing the show to explain the action of the four

machine. No one experienced difficulty recalling the segment itself.

This speaks at least for the vividness of the segment.

Sixty-five percent of the children were able to imitate the action of the four machine using the model provided. These same subjects were able to generalize the operating principle of the machine to other numbers. Twenty-three percent recalled the segment but could not spontaneously reproduce the action of the machine. After prompting and encouragement by the experimenter these children did manipulate the objects and numbers, correctly imitating the action of the machine. Twelve percent of the viewers said they recalled the segment, yet they could not articulate the principle, even with encouragement from the experimenter.

The eye movement data for those who could not respond to the post-viewing question show that their visual inspection and scanning patterns were random to the degree that often they either did not fixate objects entering the machine or did not watch the number four emerge. Of those who responded correctly to the postviewing question without prompting, all but four subjects followed the entire sequence of actions for at least one set of objects. Frequently they fixated the four objects in turn and followed the number four off the screen. When we examine the viewing patterns of those subjects who required encouragement to correctly answer the postviewing questions, no regularities are discernable. Some subjects tended to be extremely random in pattern and number of fixations distributed to various objects, while others watched at least one complete machine sequence.

In general we can conclude that children who attended most closely to the proper sequence of action in the segment and who exhibited fewest

random fixations were able to respond to the postviewing question most easily. However, even subjects who exhibited rather erratic viewing patterns were able to glean enough information from the sequence such that with prompting they could eventually work out the correct response and generalize the principle demonstrated by the segment. Yet if we consider that after viewing in the home children do not have the benefit of an experimenter to tease out the correct segment interpretation given imperfect intake of information, the burden lies on the segment to present its message clearly enough so that the instructional principle is evident in the presentation. Such segments should avoid incorporating elements that can potentially distract from the goal. We are not advocating total visual simplicity invariably but suggesting that a visually complex segment should be strong enough in its structure as to present an easily comprehensible message. The design of the Number 4 Machine allows entertainment to override education rather than striving for a beneficial balance.

#### Number 5 Grid

Viewing Patterns. The distribution of fixations on key elements was fairly consistent across subject groups. The number of fixations on the number five did not change with each new presentation, and equal attention was given to the counted objects and to the grid. The even deployment of attention over the major items of the segment is most likely a consequence of its visual simplicity and directness. There is little to distract the viewer from attending to the action; the entertainment aspects of the segment facilitate the educational message. The causal connection between the numbers five and the corresponding five objects is prominently represented in center screen by the grid. The grid is clearly a transforming agent.

The subjects did not fixate each of the emerging objects in any way that could be interpreted as a counting pattern. Some subjects would at best fixate two objects successively, usually one from the bottom row and one from the top row. Typically the children would concentrate on the group of objects. We speculate that perhaps the viewers took in the objects as a Gestalt rather than assimilating each object in turn. If the objects were spaced out, more active inspection might occur.

All but two children who simply concentrated on the scene exhibited similar viewing patterns. The children would pick up the numbers as they entered, follow them to the grid, fixate the grid while the numbers entered and finally fixate the objects as they emerged from the grid. The letter M received as much attention as the numbers five. It is evident that the format of the segment is structured enough to elicit relevant eye movement patterns from the viewers. After the initial presentation of the segment's action pattern, almost half the subjects showed viewing patterns that were clearly anticipatory. Most would anticipate the emerging objects (except during the M sequence). Some also showed expectancy of the entering five. A slight difference between the black and white samples appeared in the anticipation results with 15% fewer black children showing anticipatory viewing patterns than white children.

Postviewing Results. Subsequent to viewing the segments, the children were presented with a model of the grid and asked if they recall the machine and if they could demonstrate its action (see Procedure section). Those children whose viewing patterns consistently followed or anticipated the action had no difficulty recalling the bit, demonstrating its function, and generalizing the operating principle to other numbers. Those children

whose viewing patterns were less consistent but followed at least one complete action sequence needed some prompting from E1 to answer correctly and to generalize to other numbers. The two subjects who concentrated on the scene either could not respond appropriately to the questions even with prompting or at best answered imperfectly.

Clearly the segment was successful in imparting its message to a majority of viewers. The action of the scene was clear, simple and direct, hence easy for viewers to follow. Little if any irrelevant material was presented to distract their attention from the key instructional aspects of the segment. In general the format can be labeled visually clean.

In fact if we compare this segment to the Number 4 Machine, we can more easily appreciate this "clean presentation." The Number 4 Machine is visually complex and often encouraged viewers to direct their attention to other than the salient aspects of the presentation. The contrast of these formats is a particularly illustrative case of what should and should not be attempted in designing such number relationship segments.

Format: Conservation of Number

George's Farm

Viewing Patterns. The goal of this segment is to encourage conservation of number. A child who is just learning about the invariance of number despite changes in configuration needs to verify his new knowledge continuously. If we present him with three objects which he can count and then we change the physical display of the objects still declaring that there are the same number of things, he should be able to verify this information by counting the objects again. George's Farm short circuits this verification process by not allowing the child time to count the objects after the configuration changes. The display shifts much too quickly for the eyes to follow. The changes on the screen occur faster than the eye can physically move.

The most predominant trend of the viewing patterns was that the children generally did not fixate more than two objects consecutively. If we compare the frequency at which fixations were made on one or two objects in a sequence to the frequency at which fixations were made on three, four, or five objects consecutively, we find a ratio of 14 to 1. This ratio may reflect the fast pace of pixillation in the segment; many times only one or two objects could be inspected or counted before the display changed. The ratio may also be a consequence of the time spent watching George. Many children tended to alternate between an object sequence and focusing on George's face. George elicited 48% of all fixations.

Analysis of the fifth counting task in which five crates are stacked in numerous ways perhaps throws some light on the problems of the segment.

Of the twenty-nine children who watched this bit, only ten subjects fixated in a sequence as if counting the one through five crates. Moreover, these ten only showed this sequencing pattern during the initial stacking of the five boxes. Here we should note that the stacking took place in center screen, was paced more slowly than other sequences, and each crate could be differentiated clearly from the others rather than blending together at their boundaries. Clarity was exchanged for speed during the rest of the fifth counting task. Three-quarters of all the reported centrations for the entire segment occurred during the remainder of this section. Either the pace, timing, or lack of visual distinction among the increased number of objects, caused the deficiency of sequential fixations on the objects and the increased frequency of centration.

Postviewing Results. After viewing Show III which included this segment, each child was given a brief conservation of number test (see Procedure section). No connection was apparent between the ability to conserve and the location of fixations within this segment. No correlation was found between the ability to conserve and the amount of centration shown, the eye's reaction time, time spent on George versus the objects, or the number of objects fixated consecutively. The format and presentation of this segment does not appear to be suited to the instructional goal of teaching conservation of number.

#### No Matter How You Count Them

Viewing Patterns. In general, the subjects did not fixate the puppets sequentially while the singer (whom we will call Chiquita) was counting them. Most children did not demonstrate viewing patterns of

counting-down, inside out or around. However, thirty-eight percent of the children did demonstrate counting in the first counting-up sequence, and fifty-five percent showed a counting pattern in the last sequence.

The significantly greater effectiveness of the last sequence in eliciting a counting viewing pattern makes it important to analyze the salient features of this section. In this sequence the puppets distinguish themselves for the counting. They either enter the visual field from the side, stand up, or stand apart; they open their mouths and count themselves. In all the other sequences, Chiquita vaguely points to the puppets and counts while each puppet quickly pops his head up above the bustling of his neighbors. It is difficult for the viewer to distinguish which puppets are being counted.

Those children who did not fixate on the puppets in a manner which reflected Chiquita's counting tended to focus on random puppets or on Chiquita and her hat. In addition, they sometimes centrated on the screen and let the moving puppets pass underneath their gaze. The visual richness of Chiquita, her hat, and her active hand movements distracted the viewers who did not fixate three, four, five, or six of the puppets consecutively. These viewers might be aided by less distraction, a slower pace, a clearer delineation of the puppets, which would allow them more time and space to capture and assimilate the educational information within the segment.

## SYMBOLIC REPRESENTATION: LETTERS

Format: Individual Letters

Ernie and CM (d) Alphabet Song

Viewing Patterns. Over fifty percent of all subjects' fixations fell on either Cookie Monster (CM) or Ernie. We would expect this result given the activity of the characters, their size in relation to the other objects in the segment, and their positions on the screen. It is interesting to note that the feature of the Muppets that drew the most attention was the mouth. When human characters are fixated, their eyes usually receive the most attention, but with the Muppets their mouths appealed, perhaps because here the mouths are oversized and constantly in motion.

All of the other visual items of the scene including those manipulated by CM or the d held by Ernie were fixated with approximately equal frequency by all subjects. Three things stand out as receiving somewhat more than the average number of fixations elicited by most of the items: (1) the d produced by CM; (2) the dinner plate held by CM; and (3) CM's dunk-a-donut objects. All of these items received active manipulation by CM in contrast to some items that were simply held up to be displayed such as the doggie. In general, the items eliciting the fewest number of fixations were the signs of the words: dime, dollar, dentist, etc. When we consider the nature of those objects most frequently and least frequently fixated, an interesting contrast emerges. The items fixated least were small, appeared briefly in the lower half of the screen, and were static in terms of action. In sum, they exhibited all the negative characteristics that seem to lessen the chances of visual inspection. Whereas those elements

fixated most frequently usually involved active participation by a major empathic character such as CM. The letter d that was manipulated by CM was actively scanned, and 76% of the viewer's compared Ernie's and CM's d letters at least once during the scene.

The viewing patterns show clearly that the action of the segment attracted the children. They visually followed the activity and movement of the characters quite faithfully, alternating between Ernie and CM. The alternating movements may be likened to those one would expect of someone watching a tennis game. When the "ball" was in Ernie's court, the child's gaze would shift to Ernie and so on. Nevertheless, as we have noted, time was taken to fixate other objects when attention was called to them. This alternating viewing pattern between two interacting characters was observed in other segments discussed below, notably, D/d Dudley. We might describe such eye movement behavior as "conversational saccades."

Postviewing Results. Subsequent to viewing, all children, whether they watched this segment or not, were asked if they could think of words which begin with the letter d, the sound [d]. If no words were offered, the child was given hints to elicit d words. From the twenty-nine children who watched this segment, only twelve volunteered d words. Of these twelve, seven children gave words which were known to have been seen or heard in the segment. Clearly, the segment was not particularly successful at implanting d words in short-term memory with one visual and auditory exposure. The objects are displayed so briefly and in such non-prominent positions that this result is not surprising. Words that are only spoken in dialogue and not accompanied by visual reinforcement are even less likely candidates for retention and recall.

This segment is very entertaining and was enjoyed by the children, but as pointed out above, the entertainment aspects sometimes compete with the educational goals. There are ways by which the goal of teaching words beginning with a particular letter can be more effectively achieved without sacrificing entertainment quality. This segment could incorporate repetition of words, slow the pace, limit the number of words presented or use more familiar words, and accompany all spoken words with readily identifiable visual counterparts prominently displayed near the center of the screen.

#### Skywriter D

Viewing Patterns. The children's fixations on the opening group scene were fairly well distributed over all the major elements. The viewers paid little attention to irrelevant background items. The most active characters -- Luis, the black boy, and the girl pulling the wagon -- drew the most attention, each receiving about 20% of the total fixations on the scene. The major objects in close proximity to these characters were also actively scanned; the bike and wagon drew another 20% of the fixations. We have observed that viewers given a complex visual scene will prefer to inspect active characters as well as those objects in close proximity to the characters or those which are an integral part of the action, such as the wagon pulled by the young girl.

While each pattern of fixations on the skywriter's D varied with individuals in terms of specific details, we can draw certain generalizations. Perhaps the most significant feature to emerge from the results is that all subjects pursued the formation of the letter D to a greater or lesser extent. Most children would begin their viewing pattern with the

left-hand vertical and pursue the emerging line until the letter was completed. The pursuit movements were often not smooth but contained many regressions back along the path. Frequently viewers would anticipate the movement and jump ahead of it particularly to the closure point. These subjects would then exhibit a regressive saccade to where the line was still appearing. In general, the viewing pattern would outline the shape of the D. Some subjects in outlining the letter would occasionally flick their visual focus to the center of the D almost in an attempt to take in the entire form as a Gestalt.

For the most part, the format of this segment is successful in encouraging inspection of an individual letter. The pace at which the shape was formed was not too fast allowing pursuit and not so slow as to engender boredom. Once the letter was fully formed perhaps more time could have been allowed for inspection with a continued voice-over, or perhaps the skywriting could be repeated. In addition, the voice-over during the skywriting could have been more closely tied to the D, discussing the progress of the line in directional terms. This format would appear to be effective in teaching letter shapes and in encouraging long-term inspection of an individual letter, yet it is still entertaining since skywriting is a novelty to most children.

#### D/d Dudley

Viewing Patterns. This segment presents a visually clean scene. Line drawings and a blank background minimize visual distractions and enhance the segment's visual simplicity and clarity. Once again there were no differences between groups in the locus of fixations. Seventy-four per cent of all fixations were on Dudley and the man with glasses, while 26%

fell on the capital or small letter d. It is not surprising that within each subject group Dudley and his partner were fixated almost three times as often as the letters since the characters occupy the greater portion of the screen, are significantly larger than the letters, and are present longer. Additionally, the characters are attractive because they are animated and carry on a conversation. The letters might have received a larger portion of fixations if they had been placed higher, perhaps at the characters' eye level, or if they had been manipulated more by the characters.

The children's viewing patterns exhibited an interesting regularity. Subjects tended to fixate the character who was speaking at any given time, alternating regularly from speaker to speaker mimicing the conversational pattern. We also noted this "conversational saccade" pattern in Ernie and CM (d) Alphabet Song. The visual simplicity of the scene probably supported such a regular visual inspection pattern.

The sound-track appeared to be a significant factor in directing the fixation pattern. Over 87% of the viewers directed their fixations to the appropriate letter d when it was mentioned by the speaker. Apparently, the visual simplicity of the segment minimizes distracting elements that, in other segments, might compete with the power of the audio to direct visual inspection. The effectiveness of this segment to elicit any visual scanning of the letters lies in its visual simplicity and lack of irrelevant detail which gives the audio complete authority in directing the viewer's fixations.

### Sand Animation D

Viewing Patterns. The majority of the children who viewed this segment centrated throughout the entire presentation. Centration means that the child did not move his eyes about the television screen, but that he tended to fixate in only one spot and let the image move under his gaze. Sixty-nine percent of the fixations on the D, d were centrated while 31% reflected active scanning. This result is not surprising since the figure and the letters were placed in the center of the screen. Also the sand framing around the edges of the screen served to reinforce the centration.

If we divide the letters into thirds (top, middle, and bottom) the tendency to fixate the middle of the letter is repeated. For the capital D, 61% of the fixations occurred in the middle portion of the letter, 23% on the top, and 16% on the bottom. The lower-case d showed similar percentages. Although there was enough time for the subjects to actively scan the letters, they did not seem interested in doing so. It appeared that the children had difficulty in visually following the quick movements of the figure. Thus, when they could rest on a static element, they centrated. Unfortunately, the static element is the letter and not the figure. Moreover, this "resting tendency" was not challenged by the central placement of the letters. If more active scanning of the letters is desired, then more animation of the letters is needed.

### Fractured Letter b

Viewing Patterns. This short segment involves three people running around trying to properly piece together the parts of a letter b. The

viewers' visual attention is divided almost equally between the people and the pieces of the b. About 48% of all fixations were on the people compared to 52% on the b. The children showed slightly more interest in the b when it was carried around as opposed to when it was stationary. When the pieces of b were positioned, attention favored the people. This finding is surprising since the b is in the center of the screen and the subjects have generally tended to fixate the central image. However, as we have noted in other segments, the active moving element draws attention from the static elements of a scene. Once the pieces were put down, the children could see that they did not fit together, and their attention was attracted to the moving characters.

We have observed that when inanimate objects are placed in close proximity to live characters significantly more fixations are registered on the objects than when they appear alone. Further when the character manipulates the objects, as is done in this scene, the attraction of the objects is even stronger. What appears to be operative here are three principles, namely character movement, close proximity to live characters, and manipulation by live characters.

The last scene of this segment when the letter b is left alone on the set is similar to the last scene of Ernie and CM (d) Alphabet Song when the D remains behind. However, one significant difference exists: the duration of the letter on the screen. The letter D is left on the screen only long enough for one quick fixation whereas the letter b remains for a considerable amount of time. Most of the children actively scanned the b while the voice-over functioned to keep the child's gross attention on the screen. This last display of the b effectively elicits

visual attention because it is relatively large, placed in center screen free of distracting elements, and displayed long enough to allow scanning movements to occur.

Another possible format for this type of segment is the "Humpty-Dumpty" approach. The b appears whole first, falls apart, and the people attempt to put it back together again (of course, succeeding). This nullifies the surprise aspect but builds up expectations encouraging scanning of the letter throughout the segment.

#### Computer Animation H

Viewing Patterns. As we point out in other parts of this report, the viewer generally tends to watch the moving activity of the scene and when there is nothing moving will tend to focus on objects near the center. This segment is effective in attracting the viewer's visual attention to the letter H by the fact that it presents the letter ten times in center screen often utilizing it in the action of the scene. Every child fixated on almost all of the Hs. Few, however, actively scanned the letter. Most children fixated consistently on one part of the letter each time it appeared. Fifty-eight percent of the fixations on H were on the cross-bar or just above it. The remaining fixations fell equally on the left and right verticals.

During each presentation of an H-word most of the viewers followed the action of the scene -- alternating between hair changes and the eyes, scanning the horse's legs, head and body or the hawk's head and falling feather, and following the circling hula hoop. The visual presentation attracts and maintains visual attention, but whether it effectively teaches H-words is questionable when we consider the postviewing results.

Postviewing Results. After viewing the Sesame Street material, every subject, whether he watched this particular segment or not, was asked to think of things that begin with the letter H, the sound [h]. If the child did not volunteer any words, the experimenter prompted him by holding up her hands and asking "what are these?" or by holding out a lock of hair and asking "what is this?" The experimenter would explain that "hands" and "hair" are words that begin with the letter H and would repeat her request for H-words from the child. Of those who did not view the Computer Animation H segment, only 27% offered any H-words, none of which were mentioned during the segment. Of the thirty children who did view this segment, 43% offered H-words, but of the total thirty only four children or 13% gave words that had appeared on the show. The children who offered words did not differ in any apparent way from those who did not.

Despite the fact that many of the children were apparently not yet attuned to the idea of beginning sounds, a clear weakness of the segment was pointed out by one of the boys. With the experimenter's prompting, he recognized "hands" as one of the words in the show and he offered the word "hippopotamus." He then commented that "Maria doesn't begin with H and they showed Maria." Several times children named the objects with a non-H word before the voice-over occurred -- "chicken" for hen, "eagle" for hawk. After they have named the objects for themselves, more than likely the voice-over goes unattended. The classroom teacher can catch misnaming after it occurs, but television productions cannot and therefore must practice preventive techniques. It is suggested that the voice-over name the objects before and after they appear. In addition, objects should

be chosen which are unambiguous visually and which cannot easily be labelled in more than one way (e.g., hippopotamus).

Format: Blending

CM F-OOD

Viewing Patterns. This segment demonstrates a format which consistently elicited a viewing pattern relevant to the segment's goal. All of the viewers showed uniformity in both the number and locus of fixations. By far the largest number of fixations fell on CM. This comes as no surprise given his size, movements, and placement in the scene. Fixations on the letters fell into the following hierarchical order: F = 36%; O = 33%; O = 23%; D = 8%. What is most notable here is that the subjects tended to stay with the center of action throughout most of this scene, moving only when the action shifted. Letters more often near the center of action attracted more fixations.

The pattern of fixations rather than the distribution is the most significant aspect of the data for this segment. The majority of subjects fixated from left to right, reflecting the movements of CM. As CM moves from the F to the first O and then to the second O, the subjects' gaze was likewise directed to these specific letters. When CM returned back to the left side of the screen to the F, the subjects' attention, in turn, would follow. A left to right scanning pattern in imitation of CM's movements and voice was quickly established. This pattern of scanning became so well ingrained in some children that their eye movements began to anticipate the movements of CM. The segment format was able to clearly establish the model of a reading saccade on the part of the subjects, and CM successfully managed the dual task of directing both the entertainment and education.

While the format definitely shaped inspection schemas within the scene, it failed to direct attention to the final letters. The second O and the D

were not scanned as frequently as the F and the first O. We feel that this is because CM did not move directly behind these last two letters while he was sounding out the letter sequence. As we have remarked before, active characters facilitate the focussing of the viewer's attention on static elements. CM should be used to full advantage by moving behind each letter.

In summary, both the voice and the movements of CM contribute to the ability of this format to elicit relevant inspection patterns on the part of the viewers. Having CM hide behind the letters was especially successful in that he offered intrigue and interest without detracting from the letters. However, future instructional pieces of this kind would benefit from seeing that the activity is more evenly distributed across all the key elements in the scene.

#### F-UN

Viewing Patterns. The consistencies found in the subjects' scanning patterns for this segment were related to the format and action. Forty-percent of the fixations fell on the letter U. This is to be expected since the U was in center screen, and there was little conflicting action to distract the viewer's attention. When the F appeared and started to approach the other letters (U and N), all but one of the subjects shifted their attention to the moving element. Consequently, the F received 30% of the fixations. The N, which was the furthest removed from the action, received only 22% of the total fixations; most of these occurred while the N moved at the segment's end.

Unlike the CM F-OOD segment where CM directed the visual attention with his movements, there was no such character or technique to fill that

role here. Therefore, it is not surprising that 82% of the subjects did not show any signs of blending in the pattern of their fixations. Instead the viewers produced almost random patterns, alternating between two letters or fixating all three in a non-blending order. In fact, it seemed that the lack of either sufficient entertainment or visual direction left some of the subjects slightly bored. Several looked away from the television or began to fall asleep. Eight percent of the fixations fell on the fence which was the only other visual element on the screen.

Here we have a format which is "visually clean" but which lacks the power to accomplish its goal in the way that the CM F-OOD segment does. Only the soundtrack attempts to direct the blending movement. Even the audio has its weaknesses; one child who could not read yet thought the word was ONE until the voice-over more clearly shouted the whole word at the end. The livelier use of the letters during the blending (particularly the U and N) or the addition of a character such as CM is needed to focus and maintain attention on the letters in a way that reflects left-right reading patterns.

Postviewing Results. After viewing, all subjects were asked if they could think of any words which began with the letter F, the sound [f]. About three-quarters of the subjects did not spontaneously offer F words. Of the remaining subjects who did offer F words, only one said the word "Food" and no subjects replied "Fun". We had expected more responses of "Food" considering the effectiveness of the CM F-OOD segment both in entertainment and education, but one presentation does not appear to be sufficient.

Format: Alphabet

Fishing Boy

Viewing Patterns. The multiple letter presentation of this segment is not completely successful in drawing the child's attention to the sequence of alphabet letters. The typical viewing pattern alternates fixations on the fishing boy with fixations on one or two of the letters. The boy in center screen drew 42% of the total number of fixations; the remaining fixations were divided between the letters and the other objects available for inspection (e.g., the fishing pole and string, the basket, etc.).

This segment is nicely designed in that it builds up expectations of what is to appear next on the fishing line, and the child looks at the letters when they come to verify his expectations. All but one or two of the children focused on the letter A and the letter B when they appeared, but as the string of letters became longer the number of letters fixated remained low.

Of the letter group C-D-E, over half of the children fixated on C and D. Of F-G-H-I-J-K, over half fixated on F, H, and J. Of L-M-N-O-P, over half fixated only on N. Of Q-R-S-T, over half fixated only on R. More than half fixated on both U and V; and of W-X-Y-Z, over half fixated on X and Y. It appears that one, two, and sometimes three letters are the limits for attending to multiple letter presentations of this kind. Only six children ever looked at all four letters in a four-letter group. Only two children looked at all letters in a five-letter group, and only one child looked at all the characters in a six-letter group. If we do not consider the single-letter presentations of A and B, we find that

77% of the glances at the letter groups involved fixations on only one or two letters and 17% involved fixations on three letters of a group.

It is possible to argue that the children are picking up the other letters in their peripheral vision. This is probably true, but the information available from the periphery is vague and inferred. Visual perception or visual acuity is best when the material of interest is actually fixated and brought into foveal view. Only then can the child learn to visually discriminate and differentiate the letter characteristics. Using a smaller number of letters in each letter group would facilitate this discrimination learning process by encouraging the child to fixate each and every letter of the group.

We should also note about the viewing patterns for this segment that a disproportionate amount of time was spent looking at the fishing boy when we consider his relatively inactive role in the scene. We have hypothesized that his position in the center screen has much to do with his attraction, as well as his size in relation to the other objects in the scene. Additionally, he is a "person," as opposed to an inanimate object and therefore perhaps more compelling than other elements of the scene.

## COGNITIVE ORGANIZATION: CLASSIFICATION

Format: Delineated Board

Here are some...(Function, Shape)

Viewing Patterns. The results obtained on this classification segment indicate rather predictable trends as well as consistencies across the subject groups. Fully eighty-five percent of all fixations by all subjects fell on the classification objects and classification board as opposed to live characters in the segment. This is a predictable trend since the classification board along with the objects for comparison occupied the major portion of space on the screen and remained in the critical central focal area during the segment. The ratio of fixations between objects and characters is virtually the same across all subjects, male and female, black and white. This finding is indicative of the power of the segment format to elicit very consistent information intake across a diverse population. Although as pointed out above, the objects were fixated much more frequently than characters, it is important to note that at the segment opening all subjects acquired and fixated the characters first. Such an observation supports the notion that live characters are primary and effective tokens for eliciting the attention of viewers.

Throughout the segment the single element fixated most frequently by all subject groups was the Cheese. The Cheese occupies the central upper position of the board, and this position conforms to the central area of the screen considered as a whole. This finding contributes to the growing collection of evidence in our report that this particular area of the screen is a powerful focal area and that objects situated

within it, especially in a fairly static sequence, will be fixated most often.

Second to the central area of the Cheese, all subjects demonstrated a visual preference for the right side of the board. Such a finding would seem in accord with the fact that a central character, Luis, is positioned to the right of the board and actively manipulates the items on the right side. Fixations were particularly concentrated on Luis' hands and the Hamburger. Next in interest was the black boy on the left side who received as many fixations as Luis' face on the right side. The other left-hand objects merited attention when they were pointed to by Luis or the black boy.

For a majority of subjects in the sample the pointing action of Luis' hand was a significant factor in directing the pattern of fixations. One child in particular was motivated to the point of naming the objects with Luis as well as following the action of his hand with her gaze. The ability of a live character for whom viewers have an affective bent can be an extremely salient device for directing attention to significant portions of the stimulus.

A large number of subjects' inspection patterns showed an alternation between various objects positioned on the board. Such a pattern demonstrates the ability of the segment format (i.e., the delineated board) to encourage inspection of the various features of the items. Here the use of gesture (pointing) and a series of different camera shots (close up and wide angle) could be employed intelligently to enhance and encourage the alternative inspection and comparison of the different items by placing them each in turn within the central focal area of the screen.

Here are some... (Size)

Viewing Patterns. All categories of subjects were again substantially consistent in their viewing patterns. In the opening scene, the live characters drew the initial fixations as opposed to the objects, yet by the end of the scene the triangles had received as much visual inspection as the people. In the second scene when the board is presented alone, the three large triangles elicit much more attention than the small and large choice triangles. In fact, the middle of the board including the blank space attracted the most fixations. Again, the central screen position appears to be important in a relatively static scene. The full group of Luis, children and classification board appeared in the last and longest scene. Fifty-six percent of all the fixations on this scene fell on the board; 29% fell on the live characters and 14% on the actors' hands while pointing or gesturing.

Of the fixations on the classification board in the last scene, 32% were directed toward the small triangle in the upper right position. We can hypothesize two reasons to account for the amount of time spent attending to the smaller triangle. First, the smaller triangle represents the single different item in a set that varies along only one dimension, size. The larger triangles do not differ in texture or color and, in a sense, are predictable information for children in the age range of our sample so less inspection time is devoted to them. A second reason for concentration on the smaller triangle is that the actors gave much more verbal and gestural attention to the smaller triangle than to the other parts of the board. Luis and the black boy spend a majority of their time discussing the small triangle. In addition, the larger

triangles are often obscured visually by the children's bodies so comparison inspection is difficult and not encouraged by the visual presentation. In fact, of all the fixations on the live characters in this scene, 61% fell mainly on the back of the black boy's head because it is so visually prominent in center screen.

As mentioned above, 14% of the fixations on the last scene fell on the hands of Luis, one of the girls, and the boy, while pointing and gesturing. Twenty-two out of the twenty-nine children who saw this segment visually followed Luis' hands as he pointed out the objects. Unfortunately, much of Luis' and the children's other pointing was undirected or directed to the blank space and the smaller triangle. As we have observed above, these elements received more than their fair share of attention.

#### Comparison

The two classification segments discussed above employ substantially similar formats, yet the eye movement data clearly demonstrate that the first segment (Function, Shape) will be more successful than the second (Size) in teaching classification or at least in clearly putting across the instructional message without sacrificing entertainment quality. The segments differ in a number of important ways.

First, the visual involvement of the live characters differs significantly. In the first classification segment the two major characters are on each side of the board but do not hedge in on the display. As mentioned above, fixations were split equally between Luis and the black boy, but significantly more fixations fell on the objects. In the second

classification segment, the characters draw attention away from the objects by blocking the objects with their heads, bodies, and arms. Visual inspection and comparison is virtually impossible. Only the small triangle and blank square are always clearly visible and these areas received the majority of the fixations on the board (55%). Obviously if the purpose of the segment is to present the classification categories clearly then the live characters should direct inspection of the board while remaining visually secondary.

Direction of visual inspection is the second area in which the segments differ in effectiveness. In the first segment the pointing gestures of Luis and the black boy are well executed. They both reach out and point closely to the objects under discussion. The viewer's eye is drawn to the moving hand and to the object indicated. In the second segment the pointing is less effective and not directed clearly to all the triangles. Consequently, there is less comparative inspection of the classification elements in the second segment than in the first.

Additionally it should be noted that the items in the first segment are visually interesting while the items of the second segment, varying along only one dimension, are rather visually monotone and unexciting. This observation suggests that compensating techniques should be employed in the second segment to encourage comparative visual inspection. These techniques might include effective pointing by the actors, zoom or panning camera shots, or superimposing the choices on top of the board items for comparison.

Despite the differences between these segments, the use of the delineated board format with live characters appears to be successful in eliciting advantageous visual attention patterns from all subjects.

Format: Multiple Classification

"Ball" Hooper

Viewing Patterns. This segment incorporates structural properties that influence its effectiveness and ability to elicit visual inspection. Two factors to consider are (1) the visual variability of the scene (i.e., the number of shapes, textures and objects it contains) and (2) the close proximity and juxtaposition of objects and characters. The set presents the viewer with a densely packed and visually diverse mosaic.

The children showed little significant variation in their viewing patterns. Half of the subjects exhibited a slight preference for Mr. Hooper and half for the beach ball. The almost even split in number and duration of fixations between Hooper and the ball may be due to Hooper's close proximity to the ball throughout the segment. Such proximity may yield a unitary visual image.

The viewers attended to Mr. Hooper and the ball together significantly more often than any other elements in the scene. We can speculate that this difference is a function of Hooper and the ball's position and size on the screen. Furthermore, Mr. Hooper represents the most active agent in the segment, manipulating and discussing all of the classification objects including the ball.

The general inference to be drawn from these results is that size in relation to the scene as a whole, position on the screen, and level of activity are significant factors in inviting visual inspection. Big Bird attracted many less fixations than Hooper and the ball despite the affective meaning he holds for children. This finding is consistent with his relative size, position, and activity in the scene.

The number of fixations on the objects in the classification boxes was relatively equal for all subjects. Given the fact that the objects' exposure times were manipulated by Mr. Hooper and were fairly equal, the structure here is obviously a factor controlling the viewing pattern. As a group, the children did not engage in alternative inspection and comparison of the ball to the various items in the boxes. While a comparison was implied by the audio on the part of Hooper, no visual cues such as gestures were used. As a consequence, viewers were not motivated to read the segment as classification. With a specific goal such as classification in mind, the segment should use additional visual cues to elicit visual comparison.

The children were very active in their inspection from item to item. After the sequence of boxes had been worked through, some subjects took time to reexamine the boxes and objects in the scene. The typical viewing pattern followed Hooper from box to box, item to item. Here it is obvious that the movement of Mr. Hooper within the segment and the steady linear progression from scene to scene was highly influential in structuring the children's viewing patterns.

Quite a number of irrelevant background items such as stools, signs, and glasses were fixated by the subjects during the segment. Given the high degree of visual variability of the segment the inspection of irrelevant detail is not contrary to expectation. Such visual variability did not in this instance interfere with the desired attention to key items because most of the complexity of the scene was removed by using close-up shots of Mr. Hooper and his materials.

In general the structure and movement of the segment adequately encouraged subjects to attend to target items. Yet the action was not structured visually in such a way as to encourage significant comparison between the item to be classified and the classification categories.

### Umbrella Regrouping

Viewing Patterns. The umbrella classification segment represents yet a third type of format to teach classification. In comparison to the other two formats, the umbrella segment is the least structured. This lack of structure is reflected in the eye movement data.

The segment presents the viewer with three comparison sequences: large/small; striped/plain; fringe/no fringe. Out of all the possible comparisons that the viewers could make, only 48% were actually executed. Most visual comparisons occurred during the large/small sequence. The other two sequences elicited almost as many comparison patterns. The only real encouragement for making comparisons was given by the voice-over which designated the groups for classification. There were no marked visual cues to delineate one group from another for any of the classification categories. When the characters were ranged across the screen they tended to be read visually as one group. Subjects tended to focus around the central portion of the screen, ignoring the extremes.

The sole dimension along which fixations seemed to be grouped differentially was age of the characters: children versus adults. For all subjects fixations on children were significantly greater than those on adults. This could be either a result of the viewer's identification with the children or due to the children's constant activity which attracted

the viewer's eyes. In any case, the child/adult contrast is an unnecessary and distracting factor in effecting the goal of the segment.

The visual patterns, generally random, were especially so when the characters were moving about. Subjects pursued one character or umbrella until another movement triggered a change in fixation. We have noted earlier in the discussion of "Ball" Hooper that when items are placed in close proximity within a scene they may be treated as a unitary phenomenon. We suspect that this is true of the umbrellas and people. It was difficult to determine whether the umbrellas themselves or the people were being attended to. However, there was one exceptionally clear case in which a white male subject actively sought the character behind the umbrella. He would look above, below, and to the side of the umbrella in an attempt to locate the character, and would never actually fixate the umbrella.

Given the lack of tight structure and definition in the format of this segment, fixations predictably fell along the dimension of adults versus children. Given no attention-directing visual cues, the patterns of fixations tended to be random. Where the goal is to teach classification and elicit comparison between objects, the formats with greater structure, direction, and clear group delineation are preferable.

## THE CHILD AND HIS WORLD

### Sesame Street Opening

Despite its repetition in different Sesame Street shows, the pace of the opening bit is such that all the children were attracted and watched. Many sang along with the soundtrack. As in other segments, the active elements and the central area of the screen attracted the viewer's eyes. Although some centration occurred when the cutting rate was fast, as when the children's faces are shown one after the other, the opening segment generally elicited active scanning.

When children of both races appeared on the screen simultaneously, 79% of the initial fixations of all viewers fell on the black child first. In most cases the black child occupied the center of the screen and/or was active. Only in one scene where a black and a white child were riding a horse together were the fixations equally divided. The black boy received 59% of the first fixations on this scene and the white boy, 41%. In this case neither boy is more active nor more central. Thus, there did not appear to be an interaction between one's race and the race of the character visually fixated first. This is obviously not to suggest that there is no value in presenting scenes of children of different races together. The finding does point out, perhaps, that the format is sometimes so powerful that affective issues are subordinate. Yet in the static scene of Big Bird and the little girl we discover that 81% of our sample focused on Big Bird -- a consequence of his affective value? In any case, Big Bird should definitely be used in the opening since he is a significant symbol of the show as witnessed by his visual attraction and high recognition level on the Sesame Street Familiarity Test.

### Play to Grow Bridge

Viewing Patterns. This particular segment which presents multiple moving images before the eyes elicits in the normal child a physiologic reflex called optokinetic nystagmus. Purkinje first noted this phenomenon in Vienna in 1825 while observing a crowd at a cavalry parade. The eye picks up on a figure and pursues it to a certain point and then quickly flicks back to pick up a new figure. Everyone in our sample showed optokinetic nystagmus while viewing this segment. The children usually focused on the heads of the foreground figures and also on the shadow figures when they appeared. It is unknown whether or not or to what extent this eye movement pattern interferes with the normal visual intake of information. However, as a low content Bridge, this segment functions quite well in maintaining the child's attention.

### Special Olympics

Viewing Patterns. During the introduction to the Special Olympics, 34% of all fixations fell on Tanya, the mentally retarded child. Most of these were concentrated on her face. Interestingly enough, five subjects found her feet or shoes worthwhile visual material. We could suggest that Tanya elicited the majority of the fixations because she was "different" somehow, and this is probably true to a certain extent. However, Tanya clearly fits two of our attention-grabbing categories; she is in the center of the screen and she is the most active character. Bob, also in center-screen and active, received 30% of the total fixations, just slightly less than Tanya. The other girls were attended to in order of their participation in the segment. The girl to Bob's left spoke the most and

attracted 17% of the fixations; the girl on Bob's right received 12% and the girl on Bob's far left, 8%. To a large degree the audio directed the visual inspection during the introduction.

During the showing of the wheelchair Olympics, 92% of our sample looked mostly at the faces of the contestants and spectators. The remaining 8% alternated between faces and legs. One might hypothesize that the information areas of this segment are the wheelchairs and limbs of the occupants, but the eye movement data does not support this prediction

### Monster Opera

Viewing Patterns. All of the children watched this segment in essentially the same way. During the scenes when Bert and Ernie converse in their bedroom, the children fixated the face of the speaker, alternating between the two Muppets. Since the action rests solely on the audio track in these scenes, frequently the viewer became bored and restless, looking away from the TV screen. Often miscellaneous aspects of the scene were looked at, particularly the moon, the lamp, and the letters E and B on the headboards. It would appear that in order to retain the child's visual attention, the characters should engage in more dynamic interaction, the bedroom should be made visually richer, or varied camera techniques and camera angles could be used to create a more varied visual fare.

The monsters' song and Ernie's song were extremely attractive to all the subjects. If attention was lagging during the previous bedroom scene, it was caught without fail as the first monster appeared. In fact, one

child who watched the show just after an exhausting first day back in school began to fall asleep during Bert and Ernie's scene. He perked right up while the monsters entertained but closed his eyes immediately after the segment was over. Clearly the monsters were a powerful attention grabber!

As the camera focused on Sesame Street in prelude to the monsters' appearance, the children actively scanned the street scene perhaps in anticipation. Each child quickly picked up on the entrance of a monster and followed his actions closely. Many actively scanned the street again when the monster group disappeared.

Similarly, during Ernie's song the monsters attracted much visual attention. The typical eye movement pattern involved an alternation between Ernie's face and the monsters' faces resulting in an almost equal number of fixations on both, with the monsters drawing slightly more attention. One-fifth of the eye movements during the same scene were focused on other items, including the lamp, the drum, the drumstick, Bert's head bouncing in response to the beating of the drum, the letter B on Bert's headboard, and Ernie's pillow.

As the balloons began to fall many children would follow a particular balloon then switch to another. Less than a third of the children continued to actively scan the scene as the balloons fell in greater numbers. At this point, most subjects tended to concentrate, to stare at the center of the screen or on the pile of balloons gathered in the street.

Previewing Results. As described in the Method section, the children were asked about monsters after they finished identifying Cookie Monster in our Sesame Street Familiarity Test. The questions given below

were used as standard opening probes. Clarification of the child's answer in many cases required further questioning.

Question: You know, a little girl named Susan came to visit us yesterday, and she said that she didn't think that Cookie Monster was a real monster. Do you think Cookie Monster is a real monster?

Only two children out of the thirty questioned said that Cookie Monster was a real monster. One white male said that Cookie Monster was real but not scary; he commented that the monsters on the "Double Creature Feature" were real, but they were scary. The second child, a black male, claimed that Cookie Monster was a real monster because he eats everything, but even so, monsters didn't scare him. Of those who said Cookie Monster is not real, many gave the information that Cookie Monster is "a play monster," "people in costumes," "a puppet," and "just a hairy animal that can talk."

Question: What are real monsters like?

The composite real monster chases and scares people, eats people, has big sharp teeth/claws/fingernails, breaks down and blows up houses, and does not talk. "Dracula and King Kong are real monsters."

Question: Do you ever think about monsters?  
Do you ever dream about monsters?

Sixty-three percent never think about monsters and 53% do not dream about them. Twenty-three percent do think about monsters and 37% dream about them. The remaining 14% and 10% answered "sometimes."

Question: Do Cookie Monster and the other monsters you see on Sesame Street scare you? Do monsters like those you see on "Double Creature Feature" scare you?

Sixty-one percent said that real monsters, like the "Double Creature Feature" monsters, scare them; on the other hand, Sesame Street monsters do not frighten them. As one girl phrased it: "Harry isn't supposed to scare."

Thus prior to viewing the Monster Opera, the 5 to 6-1/2 year old children in this sample verbally distinguished between Sesame Street monsters who are not scary and what they considered "real" monsters who are scary to most of them.

#### Postviewing Results.

Question: Do you remember how Bert was trying to to to sleep and Ernie kept bothering him? Boy, I'm telling you, that Ernie just wouldn't let Bert go to sleep. Do you remember why Ernie kept waking Bert up?

All of the children gave an answer to the effect that Ernie "was dreaming"; "he thought he saw monsters but it was only imagination;" "monsters kept scaring Ernie." Despite the fact that the children were aware that the monsters were in Ernie's imagination, some children endowed them with a certain concreteness when offering alternative methods for ridding oneself of bedroom monsters -- "get a gun and shoot 'em"; "throw them in the lake"; "punch 'em in the nose." Ernie's drum was much too peaceful, it seems. Nonetheless, the concreteness of the monsters was actually reinforced in the segment itself. Occasionally Ernie and the monsters would react physically to each other's touch. Such inconsistencies can certainly confuse a child's reality/fantasy distinctions.

Question: That's right; he thought he saw monsters.  
What did you think of those monsters? Were they  
real monsters? Did you think they were scary?

The same two children who said Cookie Monster is real answered that Ernie's monsters were real. However, both said that the monsters were not scary. The rest of the children concurred that the monsters were not real in their terms ("they were Indians and dogs") and that they were not scary. Many added that the monsters scared Ernie but did not scare them. It is important to add that such words as "real" or "imaginary" may not hold the same meaning for the child as they do for the adult. In addition, a child could glibly say that the segment was not scary and still retain an image in his visual storehouse which might later frighten him.

Pupillary Response. As mentioned in the Apparatus section, our facility can measure pupil diameter. The pupil responds to changes in brightness by dilating or contracting and also responds to emotional and cognitive arousal. It would seem reasonable to examine pupil diameter changes while the children viewed the Monster Opera except that no one knows how the quickly changing television illumination affects the pupil diameter adjustment. Our one pilot subject gave us hope that the pupil information could be used because his pupil dilated significantly and stably in response to the monster scenes and gradually contracted to its pre-monster level while Bert and Ernie sang and the balloons fell. Unfortunately our test subjects were not nearly so ideal. Ten out of thirty viewers showed a large relative pupil diameter change while watching the Monster Opera, but no characteristics emerged that classified the complete response of these children as being different from those who showed no pupil change.

Despite these findings, it is our belief that pupil diameter is a potential tool for studying the child's affective response to television. However, basic research is needed to determine the characteristics of the pupil's response to the changing light values of the television presentation.

Summary. The viewing patterns show that the children were fascinated by the monsters of the Monster Opera, yet the previewing and postviewing responses reveal that no child was frightened of these Sesame Street characters and that each understood that they existed only in Ernie's imagination. Since this segment has never been shown, the monsters were new to them and captured their attention much as Big Bird and Cookie Monster did when they were originally presented. One boy watched the Dog monster so intently that he imitated the Dog's lifting eyebrows by raising his own. The monster scenes are fast-paced and build up anticipation of new appearances thereby maintaining visual interest. From our observations, there seems to be no reason not to show this segment on the air, although we must note that our conclusions are limited to 5 to 6-1/2 year olds and may not be generalizable to the younger Sesame Street audience.

#### How Are You? Fine! and Reprise

Viewing Patterns. Normally with scenes involving human figures, the faces attract the majority of visual attention and this was true in the How Are You? Fine! sequence. The children looked at faces almost twice as much as hands. If we take into consideration the relative times of each actor on the screen, we find that the faces attended to most were the faces of the deaf and the hands attended to most were the hands of

David when alone on the set. Similarly, when David comes on alone in the Reprise, his hands received almost as much attention as his face.

The typical viewing pattern involved alternation between the face and hands of each major character and alternation between the characters themselves. Frequently, the children would focus on irrelevant details and many indicated their boredom by becoming restless and looking away from the television.

Postviewing Results. The children's ability to sign after viewing this segment reflects their visual concentration on faces. Only 56% could spontaneously sign correctly. An additional 19% were successful with prompting from E1 but showed difficulty in differentiating "How are you" from "Fine". Twenty-six percent failed to produce any reasonable response.

These findings suggest some format changes if one of the segment goals is to teach the actual signing procedures. Since the children focused most on hands during David's sequences alone, perhaps another instance of a single actor signing would be more effective, rather than so many group sequences. In addition, close-up and perhaps even slow motion shots of the hands themselves in center screen would increase the likelihood of goal-directed attention.

## CONCLUSIONS

Certain format design variables have emerged from our eye movement data analysis as being important in attracting and maintaining the child's visual attention. These variables can be manipulated to control visual scanning behavior in support of the instructional goal. They also have the feature of working against program goals when not controlled in appropriate ways. They have arisen through careful consideration of a variety of segment formats and are not readily apparent from simple inspection of the visual display of the show. Given the nature of the data obtained, we can describe these variables with a fair degree of empirical certitude which goes beyond mere speculation and intuition.

Each variable, isolated, operates along its own continuum; that is, given the variable pace, for example, can we use variations of pace to achieve the same scanning and attention patterns. There is not one optimum value of pace even within one segment, but a range is possible to produce a similar result. While it is recognized that these variables, far from being isolated and independent, interact with each other, we do not understand the exact nature, extent, or degree of this interaction.

More sophisticated experimental manipulation of the variables and their values is necessary before their interactions are clearly delineated. It is in the interactions where the design decisions are critical. We feel strongly that eye movement methodology is the most appropriate technique for determining the principles of interaction in order to eventually develop design guidelines for segment construction. The following paragraphs give brief descriptions of the variables we have distilled from our analysis.

Size. The size of an object or character relative to surrounding elements plays a dominant role in the attraction of visual attention. The larger the object or character, the greater its chances of being actively scanned by viewers. Size can detract from a goal by drawing attention away from crucial elements such as when irrelevant or superfluous objects are oversized. Size manipulation may be employed to differentiate the instructional aspects of a scene from the entertainment aspects.

Activity. If one wishes to attract attention to certain items within a scene, our analysis suggests that one prime method to accomplish this is to make the item move. To a large extent, more movement elicits a longer and stronger attention pattern. The animation of static objects such as letters or number often catches the eye. However, there appear to be lower and upper limits on the attraction of movement and these change with the values of the other variables. For example, attention-eliciting power is diminished when activity is not structured enough for the eyes to follow and the child to comprehend.

Pace. Closely related to Activity is pace. By pace we simply mean either the speed at which action is portrayed, the speed at which the scene and their elements change, or the speed at which the sound-track is spoken. Pace is a very delicate variable with an optimum level probably partially determined by the visual and/or cognitive complexity of a segment. If the pace of a segment's presentation is "too high", the viewer may tend to centrare and let the visual display pass under his gaze or the viewer will fixate in an apparently random pattern. The determination of the optimum level of pace and activity for a segment is presently obscure, and this is an area where future research will be well rewarded.

Proximity of Items. When items are placed in close proximity to each other, especially when they touch, the viewer tends not to discriminate carefully between the objects and they are treated to a certain degree as a unitary phenomenon. If one wishes to call attention to an object, it may be effective to place it with an animated character or near a dominant item in the scene. However, if a clear differentiation and contrast is desired between the two, then close proximity is to be avoided.

Position on the Screen. Certain areas of the screen were observed to draw differing amounts of attention. The central portion elicited the greatest amount of attention while the top and bottom, left and right, extremes drew the least attention. While the area of the screen where objects are situated was seen as a crucial factor in the instructional effectiveness of the Sesame Street segments we analyzed, the effect of position can be modified depending upon the manipulation of the other variables.

Visual Complexity. When a scene is visually dense, containing a variety of items that are potential targets for fixations, it is visually complex. The complexity of a presentation appears to have a differential effect on viewing patterns. Visual inspection tends to become more variable and diffuse with greater visual complexity. Visual complexity interacts with other design elements such that a visually complex scene can effectively achieve its instructional goal if the other segment variables are strong enough to direct the viewing pattern. In contrast, when a scene is sparse and clean, displaying few targets for fixation, scanning patterns are more regular and directed. Here, however, the pitfall is over-simplicity which leads to boredom.

Audio. The use of spoken dialogue and conversation between two characters can be used as a device for eliciting attention and inspection. When dialogue is relevant to some object on the screen, attention is often directed to the object. Conversation between characters was found to produce a particular eye movement pattern which we have termed "conversational saccades." Given two characters interacting with each other in a conversation, the subject will usually direct attention in an alternating sequence from speaker to speaker.

To Teach and To Delight. Throughout our analysis we have become increasingly conscious of the delicacy of the balance needed between the entertainment value of segments and specific educational goals. The variables we have outlined must always be considered in light of the question of entertainment quality and educational objectives. There are no easy prescriptions for achieving this balance; the issue is a subtle one. Decisions will have to be made on a segment to segment basis. However, we believe that eye movement analysis of television presentations and the identification of design variables can make a genuine contribution to the decision process.

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## Appendix A

List of Sesame Street Segments in Shows I, II and IIIShow I

Ernie and Cookie Monster (d) Alphabet Song

How Are You? Fine!

Skywriter D

How Are You? Fine! (Reprise)

Number 4 Machine

Umbrella Regrouping

D/d Dudley

F-UN

Play to Grow Bridge

Introduction to Special Olympics

Special Olympics

Show II

Here are some---(Function, Shape)

Monster Opera

Computer Animation H

Fishing Boy

Show III

"Ball" Hooper

George's Farm

Fractured Letter b

Number 5 Grid

Cookie Monster F-00D

Here are some---(Size)

Sand Animation D/d

No Matter How You Count Them

## Appendix B

Sesame Street Familiarity Test

The following is a list of the nineteen Sesame Street characters used in the SSFT in the order in which the characters were presented.

Oscar  
Ernie  
Snuffalophagus  
Big Bird  
Grover  
Roosevelt Franklin  
Hairy  
Mary Lou  
Susan  
Luis  
Maria  
Gordon  
Mr. Hooper  
Count  
Bob  
Little Bird  
Bert  
Cookie Monster

## Appendix C

### Description of Sesame Street Segments

#### Show I

##### Sesame Street Opening

This is a typical Sesame Street opening. Children of all races and various ages are filmed in both urban and rural settings; while they run, jump, climb, and talk. There are scenes of children riding horses, feeding sheep, exploring woods and playing in city parks. The segment is accompanied by the Sesame Street song which is sung by children.

##### Ernie and Cookie Monster (d) Alphabet Song

This segment features two puppets, Ernie and Cookie Monster, presenting the letter D. Ernie holds up a capital letter D and sings a song which, in the first half, names different nouns, verbs and adjectives that begin with the letter D. While he names the words, Cookie Monster either produces a likeness of the item (i.e., doggie, duckie, dinosaur, donkey, dragon, dinner ) or he acts out the various verbs and adjectives (i.e., do a dance, draw a daisy, delicious). In the second portion of the song, Ernie again lists words beginning with the letter D. Now, however, Cookie Monster holds up a card with the word spelled out on it (i.e., doctor, dentist, dime, dollar, dandelion, daddy). The song ends with Ernie's, "Having fun but now we're done!" This is an exuberant, lively, energetic and very humorous segment.

##### How are You? Fine!

This segment uses both children and adults to show different kinds of people learning and then teaching two common phrases in sign language.

The segment begins when Bob comes out of his house, stretches, and says "hello" to four adults who are walking by. One of the friends appears to be deaf and so Bob signs "Hi!" with his hand. He tells them that he is very excited because he has just learned how to say "How are you?" in sign language. He makes the signs and then realizes that he doesn't know how to make or understand any replies. The deaf woman shows him how to sign "Fine!"

His friends leave and Bob approaches a young Puerto Rican boy and teaches him how to sign the two phrases. The boy is thrilled and goes to show Maria what he has learned. Maria learns the signs and then shows them to two twin black boys, Todd and Corey. As she is leaving Maria signs to David in passing, but David doesn't understand what she has said to him until he meets the twins; they explain and teach him about the signs. David is dying to tell someone about his new knowledge, so he turns to the camera and shows the viewer. He says, "Now you try it." He pauses and then asks, "How am I?" He replies, "Fine!" in the newly learned sign language.

#### Skywriter D

The goal of this segment is to familiarize the child with the visual presentation of the capital letter D. It opens with Luis coming out of his house carrying a wrench in order to help a child fix a bicycle. Three other children appear as Luis hears a roaring noise and looks up at the sky. "Do you hear what I hear?" he asks them, "It's Alphabet Bates." The viewer then sees a shot of the blue sky as a skywriter airplane comes into view. While the audience sees the plane write, Luis asks the children to guess what letter is being formed. When the curve of the letter appears, the

children suggest that it will be the letter R or P. The skywriter finishes the letter and Luis exclaims, "A D! He made a D today!"

How are You? Fine!

This short segment serves to remind the viewer of the two sign language phrases that he/she learned during a previous segment: "How are you?" and "Fine!"

David addresses the camera from inside his ice cream shop and asks the viewer, "Remember the signs we learned?" He reviews the signs and then says, "You ask me." He pauses, and then replies in sign language, "Fine!" He repeats the two signs once more, saying the words out loud as he gestures them. When he has finished, a woman approaches his window and silently signals, "How are you?" David silently signals back, "Fine." The woman enters the shop and sits down, making a gesture as if she were eating an ice cream cone -- they both laugh as he begins to prepare a cone.

Number 4 Machine

This animated segment features a machine which transforms four objects into the numeral four, teaching number-numeral correspondence. The machine is operated by a man who sits on top of it and directs the four objects into one end of his machine, pulls a lever, and then watches expectantly while the machine huffs and puffs until a large number 4 emerges from the other end in a cloud of blue smoke. The first objects that he spots are four fire engines. He names the object, counts each one as it enters the machine and proclaims "4!" when the number appears. Next he ushers four ringing telephones into the machine, counts them and announces "4" when they

are transformed. The same sequence occurs with four ships. Finally the operator spies three men. They walk into the machine and when nothing happens, the machine man climbs down his ladder, mumbling how inconvenient it is. While inspecting the machine he walks into it; the machine whirrs and out comes a large number 4 with the four faces of the now four men sticking out of it.

#### Umbrella Regrouping

Classification is the instructional goal of this pixilated segment. A fast musical background introduces the scene of three adults and three children scurrying around with closed umbrellas. A male voiceover asks them to open up their umbrellas. The children open small umbrellas and the adults open large ones. The voiceover suggests that they arrange themselves in different groups. First he directs them to divide into two groups - one on one side of the screen and the other on the other side of the screen - according to the size of their umbrellas, which they now hold out in front of themselves. The second division is made according to who has an umbrella with two colors on it and who has an umbrella with only one color on it; there are three of each. The final division is made according to who has an umbrella with fringe and who doesn't; once again there are three of each.

The voiceover concludes that the umbrellas are alike in some ways and different in other ways. Suddenly the stage grows dark and thunder claps; as it begins to rain the voiceover adds that one thing they all do is to keep you from getting wet!

D/d Dudley

This animated segment teaches the initial sound of the letter D/d. Dudley and a second smaller male character walk onto the screen. "Just put it there," requests the second character, and Dudley sets down a large capital D. The second figure addresses the audience, "Today I want to show you the letter D. This is the capital letter D... Dudley, where is the small d?" "I ate it for dinner," replies Dudley. "Well get another one," his partner demands. Dudley removes from his pocket a small letter d and sets it down to the right of the capital D. "As Dudley has suggested," continues the speaker, "the word DINNER begins with the letter D." Dudley then picks up the capital D, and although he complains that it needs salt, happily pops it into his mouth and crunches it up. His companion is aghast and cries, "Dudley, where are your manners - don't eat with your mouth open!"

F-UN

Visual/verbal blending is the goal of this segment. At the opening, the viewer sees two letters, U and N, perched on a large picket fence in the foreground. A male voiceover announces, "These are the letters U and N. Together they sound like this - " and he pronounces the sound UN. Then a capital letter F appears in the distance on the left side, heralded by a drum roll and cymbal crash. The voice continues, "Way back there is the letter F. The letter F sounds like this." He pronounces the sound F which is followed by another drum roll and cymbal crash. Then the voice repeats the two different sounds one at a time as the F approaches the UN. The closer the F gets to the UN, the more blended the two sounds become until

finally the word FUN is voiced. A great cymbal crash and loud cheering accompany the voiceover in rejoicing, "That's fun -- Whoppeee!" Confetti flies, horns blare, and the three letters dance in place.

#### Play to Grow Bridge

This twenty second segment is a standard logo used to cue adult viewers that the subsequent segment features children with mental retardation. It consists of simultaneous multiple images of children running, walking, and jumping, accompanied by music.

#### Introduction to Special Olympics

This is a very short introductory segment in which Bob talks with four young children, some retarded and some not, about different kinds of races. He asks them if they like to race and how they race. They respond. Bob then tells them that he has some pictures of a special race run at the Special Olympics.

#### Special Olympics

This film segment is accompanied only by music and features two wheelchair races. Before the first race begins, the camera pans across the participants and cheering fans, while friends and relatives help some of the contestants to the starting line for the obstacle course race. During the race the camera focuses on spinning wheels, hard working hands and clapping, whistling fans. The winner is beset by happy congratulating friends. Then the line up for the second race -- a speed race -- begins. A gun signals the start and they're off! The happy woman who breaks through the finishing tape first is hugged

and congratulated by actress Sally Struthers, who says how wonderfully she thought her friend raced. The last part of the segment shows all of the many winners going home with medals around their necks.

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Show II

Here are some... (Function, shape)

This segment concentrated on classification by function and shape. The segment is begun by Luis who sings the Sesame Street classification song: "Here are some things that belong together..." The audience sees a board divided into six squares. In the left four are pictured a triangular sandwich, a triangular piece of cheese, a pie wedge, and a blank square. In the right two choice blocks are a hamburger and a yield sign. Luis stands to the right of the board and three children occupy the far left side of the screen. As the song ends, one child suggests that the hamburger belongs in the blank space. Luis asks the children to identify each object as he points to them. Two children then agree that the hamburger belongs in the space because all the left-side objects are things to eat. The third child, however, argues that the yield sign belongs in the blank, because then the objects are all triangles. Luis explains that both choice squares are correct, each one for a different reason.

Monster Opera

Bert and Ernie star in this ten minute Muppet extravaganza. It is a calm, dark night and Bert and Ernie lie asleep in their matching beds. Below their window, Sesame Street is quiet except for a cat's howl and a dog's bark; these noises however are enough to disturb Ernie and his thoughts turn to scary night time horrors. There is a creak and Ernie calls Bert's name with a start. He explains that he heard a "real scary, spooky, noise." Bert tries to explain that it's just his imagination and he should go

back to sleep. So Ernie crawls under the covers and tries to sleep, but he begins to let his ideas run away with him as he imagines what it must be like outside where there are no people... just monsters. In a dream like sequence the audience sees what Ernie has conjured up -- monsters start to pop up everywhere and sing a song which chills with lyrics like, "I know where I am but where are you?" and then warms with, "If the lights were on things might turn out friendly... don't be frightened of us and we won't be frightened of you!" But still Ernie cannot seem to sleep and he wakes Bert once again. Bert, who has become rather exasperated, tries to be calm but Ernie explains in a song that he sees monsters! He howls, "Go away bad things, go away!" During his song he is besieged with imaginary monsters and soon they too take up his chant. At this point Ernie is beside himself, so Bert tucks him back in bed, turns off the light and encourages him to think of good things. Bert begins a song in which he explains that "Here in the middle of imagination the most remarkable things come true." They sing together and then sure enough Ernie falls off to sleep as the room is filled with his favorite thing -- balloons!

#### Computer Animation H

This segment mixes live action with computer animation to present words beginning with the letter H. A voiceover adult and child label the capital letter H, and as the H changes into parts of the body, animals, and activities, the voiceovers identify the corresponding H words.

Fishing Boy

This animated segment helps the viewer to learn and reinforce his knowledge of the alphabet. It is a short story which is told in rhyme. A young boy is sitting on a wharf with his fishing rod in the water as the narrator begins to tell his tale. While fishing for dinner one day, a boy caught an a, then he catches each letter of the alphabet in turn. When he reaches the letter k he is rather dismayed because he can't eat this kind of catch for dinner. He tries again but all he comes up with is the rest of the alphabet. Suddenly he gets an idea and he gathers all the letters that he threw aside and cooks up a potion of letters which he proudly calls alphabet soup!

Show III

"Ball" Hooper

This segment teaches classification skills and features Mr. Hooper and Big Bird in the merchant's store. Big Bird enters and finds Mr. Hooper pondering over a big stiped beach ball. Big Bird tries to get his attention but Mr. Hooper is so absorbed in his problem that he won't listen. Instead he asks for Big Bird's advice. The shopkeeper cannot decide where in the store he should put the beach ball. On the counter in front of him are three boxes. Mr. Hooper goes to the first one and reads its label which says "Round Things." "I could put it in here," he queries. Then he looks at each item in the box; he pulls out a record, a plate, and a frisbee. Not completely satisfied he moves on to the second box which says "Striped Things" on it. In that box he finds, striped socks, a striped tie, and a striped muffler. But Mr. Hooper is still not happy and so he moves on to the third box which says "Beach Things." Inside he finds a sand shovel and a sand pail. Finally he decides to put the round, striped, beach ball in the last of the three boxes. Now he can find out what Big Bird wanted; Big Bird wanted to know if Mr. Hooper might have a big, round, striped, beach ball that he could take with him to the beach! The segment closes with a closeup of the exasperated look on Mr. Hooper's face.

George's Farm

This pixilated segment stresses the conservation of number, that no matter how a certain number of objects are arranged, or what order they are counted in, there are always the same number of objects. Farmer George, whom we recognize by his straw hat and sloppy dungarees, slides under a table top at the beginning of this segment. On top of

the table there are three wooden barrels. The barrels move around the table and the man in a kind of dance, arranging themselves into triangles, straight lines, etc. Then a young child's voice is heard, "Three is always three." And his phrase is repeated by a large group of children, "Three wooden barrels are always three wooden barrels." The second and third sections of the segment use the same format, except they feature four medal milk churns and five wooden orange crates respectively.

#### Fractured Letter b

This pixilated segment is accompanied by playful, spirited music and teaches the visual letter b. Maria and two young children, a boy and a girl, enter an empty stage, each carrying a different piece of a large, lower case, broken up, three dimensional b. One child holds the top part of the stem, the other carries the lower half of the circle and the bottom of the stem, and Maria brings the top part of the circle and the middle section of the stem. They try twice to put it together to form the letter b, but it doesn't quite work each time. Finally on the third try it works - they check once again to be sure - and sure enough it is a b! They jump for joy. One child exclaims, "That's the letter b!" and they all run off stage leaving the letter behind.

#### Number 5 Grid

This animated segment features a magical grid which transforms the numeral five into five objects. A large white grid, which is like a three-dimensional rectangle, floats in center screen and the segment is accompanied by slightly eerie space music. First, a large 5 floats towards the grid as a male voiceover says "Five." The number

passes through the grid from right to left and the voice counts 1,2,3,4,5 as five giraffes pop out of the other side of the grid; then he repeats "Five." The next 5 undergoes a similar transformation; this time five fire hydrants appear. The third time, five pumpkins appear and then five human figures emerge. Finally, a large letter M floats towards the grid. The voice sounds puzzled, "M?" When the letter tries to imitate the numbers, it is unable to pass through the grid and instead it breaks into pieces which float off in all directions.

#### Cookie Monster F-OOD

Cookie Monster attempts to teach visual and verbal blending of the word FOOD. As he walks on screen, he spies the letter F on the left hand side of a wall and the letters O-O-D on the right hand side. He crouches down behind the letter F and pronounces the sound F. Then, after a pause, he goes over to the O-O-D and pronounces the sound OOD as he moves behind the letters from left to right. He keeps repeating the two different sounds faster and faster as he pushes the F closer to the OOD. Finally he has said the word "FOOD" and suddenly he realizes what word he has said. A bell rings to signal that Cookie has an idea and he runs off screen, returning seconds later with a pair of salt and pepper shakers and a napkin around his neck. Roaring with delight, he salts and peppers each letter and then devours them one at a time. "Yum!" Not being able to contain his appetite, he then munches on the two shakers. Then, as if satisfied, he wipes his mouth with the checkered napkin... but he must eat it too!

#### Here are Some ... (Size)

This classification segment opens as Luis asks the three children

with him if they are ready to play the "Here are..." classification game. He has a poster which is divided into two sections; on the left hand side are three large triangles and a blank space, and on the right hand side are both a large and small triangle, the two possible choices for completing the left hand side matrix. After he finishes singing the song, Luis asks the children what they think the best selection is. The first child suggests that the small triangle is correct because, "It's a triangle." Luis tells him to look a little closer to find the one that is "exactly" the same. The boy and the other children then see that the large one is indeed just like the other three. As Luis moves the large triangle to the blank space, he concludes that now they are all the same except the small one. The first boy replies, "So that's why we took it off!" And Luis answers, "That's right, take it off, put it in your pocket, take it home."

#### Sand Animation D/d

This short animated segment uses sand to write out the lower and upper case letter D. At the beginning the sand mobilizes to form a large capital D, then the curve of the letter breaks off and forms a human figure. The figure runs around to the other side of the now straight line and does a hand stand against it - forming a lower case d. The only narration is a voiceover which announces the letter D each time the letter is formed.

#### No Matter How You Count Them

This lively segment features six male Muppets and one female one who sings a song dealing with the instructional goal of conservation of number. The singer wears a large bandana covered with fruit and jewelery and dances to a calypso beat. Her song explains that no

matter how you count a group of objects it is always the same number, and she demonstrates by counting the six bouncing fellows as they arrange themselves in many different patterns. She enumerates that you can "count them up, count them down, count them inside out, or count them around, but the nice part of the game is that no matter how you count them they come out the same." They all dance wildly shouting whoppeeee! and the segment comes to an end.

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